A DISSERTATION ON

ISLAND FLAPS IN PLASTIC SURGERY

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CERTIFICATE

This is to certify that this dissertation entitled "**ISLAND FLAPS IN PLASTIC SURGERY**" submitted by DR.V.JEYAKODI to the faculty of Plastic Surgery, The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement in the award of degree of MASTER OF CHIRURGIE IN PLASTIC SURGERY, Branch – III, for the August 2008 examination is a bonafide research work carried out by him under our direct supervision and guidance.

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DECLARATION

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This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement for the award of MASTER OF CHIRURGIE, M.Ch., PLASTIC SURGERY, degree Examination to be held in AUGUST 2008.

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CONTENTS

INTRODUCTION

Reconstruction in Plastic Surgery has been revolutionised with the use of flaps with a intact blood supply.Today the reconstuctive plastic surgeon faced with a soft tissue defect has a plethora of options.

Major advances in the field of plastic surgery have been made possible by the use of muscle flap,musculocutaneous flap,fasciocutaneous flap and various techniques of microvascular composite tissue transplantation

Application of precise knowledge of anatomy of the skin, muscle, bone and fascia in planning the reconstructive procedure, the surgeon has the ability to restore the form and function in congenital and acquired defects in most topographic region.

Modifications and refinements in flap design offer considerable variety and versatility in the technique available for reconstructive surgery. With application of principles of flap design and technique it is possible to simplify the approach to the reconstruction of surgical defect. Cover form and function are the three most important factors in

determining the successful outcome. By thorough analysis of each individual surgical defect the most appropriate method of reconstruction can be selected.

Island flaps are designed on the principle of transfer of tissue without an intact epitheliazed skin pedicle. Further refinements in design and techniques has reached a point where flaps are transfered on vascular and neurovascular bundles.

AIM OF STUDY

The main objectives of this clinical study are

1. To study the role of island flaps in modern plastic surgery.
2. To discuss the types,anatomical regions,planning and tecniques of execution of island flaps
3. To analyse the merits and demerits of island flaps
4. To study the post operative management and complications
5. To assess the outcome of reconstruction on the basis of form,function and aesthesis.
6. To discuss the emerging trends and future prospects for island flaps in reconstructive surgery.

HISTORY

Evolution of Flap

- The history of development of flaps can be divided in the following phases.
- An **early period** date back to various centuries from Susruta 700 B.C. to the First (1917) and Second (1942) world wars.
- The **second period** during 1950s and 1960s – Discovery of regional axial pattern flaps.
- The **third period** during 1970s when muscle and musculocutaneous flaps were developed with simultaneous development of free tissue transfer
- Distinction between Axial and Random pattern flaps were studied elaborately during this period.
- The **fourth period** during 1980s when Fasciocutaneous flaps were scientifically developed and clinically applied extensively. During the same period there was further development and clinical application of wide range of Free flap transfers.

- The **fifth period** during 1990s when Neurocutaneous flaps were described in legs , improving management of complicated lower limb defects.
- The **Sixth period** during 2000 -Propeller flaps based on perforators

Early Period

- From 700 B.C. to I & II world wars (1917 & 1942)
- Nasal reconstruction played central role in the evolution of skin flaps
- 700 B.C. – Susruta samhita - ? Graft or Pedicled forehead flap (India)
- 1440 A.D. – Kangra of Kanghiara family from near Pune of India – Pedicle forehead flap for Rhinoplasty. Kakim Dinanath Kanghiara, the last surviving descendent of the family who secretly performed rhinoplasty, claimed that his family has been practising the art since 1000B.C
- 1595 – Taglicozzi used distally based upper arm flap for nasal reconstruction
- 17th & 18th century – period of decline and neglect of Plastic surgery

- 1797 – Carpus, Graefe & Dieffenbach – Random cutaneous flap
- 1842 – Mutter (USA) – correction of burn scars of the neck with flap
- In the late 19th & early part of 20th century the scope of plastic surgery widened rapidly. It was this period when PRINCIPLES OF PLASTIC SURGERY was conceived laying down the **FOUNDATION FOR MODERN PLASTIC SURGERY.**
- Pioneers who published papers in this field are GERSUNY – 1887 , MORAX – 1908 , SNYDACKER – 1906 .
- 1913 – Trotter – Delayed flaps.
- Next milestone – Tubing the pedicle of the flap and effectively axialising the flow in the flap
- 1917 – V.P.Filato (Ophthalmologist at Oddessa)

  Dr. Hugo Ganzer (Berlin)

  Sir. Harrold Gillies (Queen's Hospital, Sidcup, England)
- Captain. Aymard performed tubed flap transfer from shoulder to nose in late 1917.
- Ganzer – Tubed pedicle of arm for repair of palatal defect in 1917.
- **Gillies** - First Tube pedicle in 1917

Second Period :

- The second major period of discovery was in 1950s and 1960s when Axial pattern flap was created.
- McGregor, Owens, Shaw, Wilson, Wookey and Zovickian described variety of flaps from scalp, forehead, neck, chest, supraclavicular area and upper back.
- Pioneers in defining distinction between axial and random pattern flaps were McGregor and Morgan.
- To start with, axial pattern flaps were executed in the head and neck region.
- Later on new axial pattern flaps were created in groin, abdomen, thigh and dorsum of foot.

Third Period

- Until 1960s, only skin and subcutaneous tissue were used as flaps.
- In 1968, GER described muscle flap.
- Later, Zukriwich, McCraw, Dibbel, Furlow, Vasconez, Mathes & Nahai, Bostwick, Maxwell, Daniel, Ariyan, Orticochea and Seratin contributed much to the understanding of blood supply to the

muscle and overlying skin, facilitating the use of musculocutaneous flaps as local and free flaps from head to foot.

- In the same period advances in operating microscope, smaller needle and finer sutures made possible the transfer of free flaps.
- First successful reimplantation of completely severed thumb was done by Komatsu & Tamai in 1965.
- Improvement in Microvascular techniques were developed by Buncke et al (1965,1966) and Cobbett (1967) conferring reliability to both Replantation and Free flap surgery.
- Harii et al carried out the first completely successful FREE FLAP in September 1972, followed by Hayhurst in 1973.
- Taylor and Daniele with O'Brien in 1973.
- Acland (1973) and others helped to solve some of the problems of thrombus formation in microvascular surgery.
- Chinese surgeons were doing Hand replantation (1963), 2nd Toe Transfer (1966), and free Groin flap (1973) but these were known to the rest of the world only in 1982 (Chen et al , 1982).

Fourth Period :

- It is the era of Fasciocutaneous flap – 1980s.
- It is the third system of blood supply to the skin consisting of perforators passing along the fascial septum between certain muscles and spreading out at the level of deep fascia to supply the skin.
- It was first done by Ponten in the leg in 1981.

Fifth Period

- It is the era of Neurocutaneous flap – 1990s.
- Another system of blood supply to the skin.
- Eg: Proximally based Saphenous artery NC flap.

  Distally based Sural artery NC flap.

Sixth Period

- It is the Era of propeller flap – 2000.
- Vascular supply to the skin is achieved by perforators. Perforators flaps have evolved from musculocutaneous and fasciocutaneous flap without the muscle and fascial carrier.

- Advantage of perforator flaps include less donor site morbidity, versatility in flap design muscle sparing and improved post operative recovery etc.,

REVIEW OF LITERATURE

FLAPS

Flaps are vascularised tissue possessing an arterial and a venous system. They remain attached to one or other parts of the body retain their vascularity during its transfer or transplant from the donor to the recipient area.

Blood supply to skin.

Skin receives its blood supply via three different vascular system.

1. Direct cutaneous system.
2. Musculocutaneous system.
3. Fasciocutaneous system.
4. Neurocutaneous system

1. Direct cutaneous system.

The direct cutaneous system of vessels (artery accompanied by veins) runs in the subcutaneous fat parallel to the skin, often supplying for a considerable distance. Axial pattern flaps with impressive, length to breadth ratios are based on the direct cutaneous system of vessels.

a. *Anatomical territory:* Anatomical territory of a vessel is the area occupied by the vessel and its ramifications before anastomosing with adjacent vessels. It is defined on the basis of anatomical dissection.

b. *Dynamic territory*: Dynamic territory of a vessel is the area supplied by the vessel after the surrounding anastomosing vessels are divided and ligated. It is always greater than the anatomical territory.

c. *Potential territory:* Potential territory is the area of skin which can be raised with an axial pattern flap beyond the dynamic territory as random extension. This requires preliminary delay of potential territory 7 – 10 days prior to raising the flap.

2. ***Musculocutaneous system:*** The musculocutaneous system of vessels arises as perforators from the arteries supplying the muscle. These perforators run perpendicular to the skin surface and spread out in the subcutaneous tissue. They freely communicate with the adjacent musculocutaneous perforators. Each perforator supply a small area of skin.Direct cutaneous vessels and musculocutaneous

perforators ramify into the subcutaneous tissue and feed the intradermal, subdermal and subcutaneous vascular plexus.

Classification of vascular anatomy of muscles

***Dominant vascular pedicle*:** The pedicle which sustains the circulation of muscle after mobilizaton as flap is called dominant vascular pedicle. A muscle can have more than one dominant vascular pedicle.

***Minor vascular pedicle*:** Flaps based on minor vascular pedicles are defined as distally based flaps

a. Type I : One vascular pedicle. e.g : tensor fascia lata.
b. Type II : One or more dominant vascular pedicle (s) and minor vascular pedicle (s) e.g: gracilis.
c. Type III : Two dominant vascular pedicles eg: gluteus maximus.
d. Type IV : Multiple segmental vascular pedicles , each providing circulation to a segment of muscle. eg: sartorius.
e. Type V : One dominant vascular pedicle and secondary segmental vascular pedicles. These muscles can be elevated

as a flap on either dominant or segmental pedicles. eg: latissimus dorsi, pectoralis major.

3. *Fasciocutaneous system*:

The fasciocutanous system consists of septocutaneous perforators which pass up to the surface along the fascial septa between adjacent muscle bellies and then fan out at the level of the deep fascia to form prefascial, intrafascial and subfascial plexus from which branches are given off to supply the overlying skin and subcutaneous tissue. Though there are three different fascial plexus, the blood supply of fascia is essentially from the prefascial plexus. Various communicating vessels connect prefascial plexus to the subdermal plexus. In the skin territory nourished by fasciocutaneous perforators, a flap with underlying fascia will survive to a greater length for a given width, if the long axis of the flap lies in the same direction as the dominant direction of the fascial plexus.

Classification :

These flaps have been classified as type A, B, C and D.

a) *Type A :* A pediculated fasciocutaneous flap dependent on multiple septocutaneous vessels at the base. eg : fasciocutaneous flaps of leg described by Ponten.

b) *Type B* : Type B flap is based on a single , sizeable and consistent septocutaneous perforator. This can be used as a pedicled flap or free flap.eg : medial arm flap.

c) *Type C.* : The Type C flap is supported by fascial plexus that is supplied by multiple small septocutaneous perforators along its length which reach it from a deep artery running along the intermuscular septum. The vascular arrangement resembles a ladder. This flap is used as island flap or free flap. eg : radial artery forearm flap.

d) *Type D* : The type D flap is an osteomyofasciocutaneous flap. This is an extension of type C flap. The fascial septum is taken in continuity with adjacent muscle and bone which derive their blood supply from the artery running in the septum. eg. radial artery forearm flap and peroneal flap.

4. Neurocutaneous system

- Sensory superficial nerve is supplied by vascular network. The nerve along with vascular network contribute greatly to the vascularisation of skin.
- Neurocutaneous flap can be considered as an Axial pattern flap.
- Greatest advantage is the absence of sacrifice of the main artery.

CLASSIFICATION OF FLAPS:

Flaps are broadly classified into two groups.

1. Pedicled flaps.
2. Island Flaps
3. Free flaps.

***1. Pedicled flaps*:**

Pedicled flaps have a pedicle or base which remains attached to one or the other parts of the body during its transfer to the recipient area. Pedicled flaps can be classified as follows:

A. Skin flaps

B. Muscle flaps

C. Fascial flaps.

D. Adipofascial flaps

E. Omental flaps

F. Compound flaps

- Fasciocutaneous flaps
- Myocutaneous flaps
- Osteocutaneous flaps
- Osteomyocutaneous flaps.

A. Skin flaps

A skin flap consists of skin and subcutaneous tissue. It can be classified as follows

1. Depending upon the *blood supply* of the flap.

a. Random pattern flap.

Random pattern flap does not have any cutaneous vessels running along it. It is dependent on the subcutaneous, dermal and subdermal plexus, which are supplied by musculocutaneous perforators. Since their blood supply is random in nature, their length to some extent, depends on the width. Their safe length to width ratio is 1 : 1 except over head and neck where skin vascularity is excellent. Over head and neck the length to width

ratio can be kept up to 1.5 : 1 . By increasing the width of the flap beyond certain limits, the length cannot be increased because the surviving length of a random pattern flap depends on the vessel perfusion pressure.

b. Axial pattern flap

Axial pattern flaps are used on direct cutaneous vascular system which runs along the length of the flap. They have an impressive dimension which depends on the anatomical, dynamic or potential territory of the cutaneous vessels. They can be subdivided into the following:

I. Depending on the anatomy of the pedicle, axial pattern flaps can be classified into

1. Peninsular flap.

Just like a peninsula it is attached to the body on one side at the pedicle. Examples are forehead flap, deltopectoral flap, groin flap.

2. Island flap.

In island flaps, the pedicle consists of only vessels with out skin bridge.It has greater mobility about its pivot

point.Examples are superficial temporal artery island flap with island of scalp for eyebrow reconstruction and neurovascular island flap from the ulnar side of the ring finger to provide sensory cover to the thumb..

II. Depending on the site of pedicle, axial flaps can be classified into

1. Proximally based flap.
2. Distally based flap.

Proximally based flaps have antegrade blood flow while distally based flaps have retrograde blood flow. Proximally or distally based abdominal flaps are used to cover the defects of the fore arm.

2. Depending on the *location* of the donor site -

a. Local flaps

i) Flaps that rotate about a pivot point

- Rotation flap.
- Transposition flap.
- Limberg flap.
- Dufourmental flap.

- Bilobed flap.
- Interpolation flap.

Donor area of a local flap lies adjacent to the recipient area.

i) Local flaps that rotate around a pivot point:

- ***Rotation flap*:** Rotation flap is a semicircular flap which is rotated around a pivot point till the defect is closed. It is used for triangular defect. If the defect is not triangular it is first triangulated.
- ***Transposition flap*:** The transposition flap is rectangular in shape and like rotation flap, it is used for triangular defect. If the defect is not triangular, it should be triangulated before planning a transposition flap. The base of the transposition flap lies towards the apex of the triangle.
- ***Limberg flap* :** Limberg flap is used for rhomboid defect with 60^0 and 120^0 angle. It is like a transposition flap, but in this flap the secondary defect is closed primarily. Hence, the cosmetic result is superior to the transposition flap.
- ***Dufourmental flap*:** Dufourmental flap is similar to Limberg flap except that it can be constructed for a rhombic defect of any angle.

- ***Bilobed flap:*** Bilobed flap consists of two flaps – primary flap and secondary flap. The optimal angle between these two flaps is 90 degrees but it may vary from 45 to 180 degrees. The larger the angle, the greater is the chances of dog ear at the point of rotation. The primary flap is planned slightly smaller than the defect and the secondary flap slightly smaller than the primary flap. The secondary flap is made triangular to facilitate closure of the donor defect primarily. Bilobed flap is rotated in such a way that the primary flap covers the defect, secondary defect is closed by secondary flap and the tertiary defect is closed primarily.
- ***Interpolation flaps*****:** The donor area of the interpolation flap does not lie immediately adjacent to the defect (unlike other local flaps). Hence the pedicle of this flap passes over the intact skin or under the skin (as in subcutaneous pedicled or island flaps). Unlike distant flaps, the donor area lies in the same region. Example: forehead flap for nose defect.

ii.) Advancement flaps -

Advancement flaps directly move forward into the defect without any rotation or lateral movement. Various advancement flaps are:

- Single pedicled advancement flap.
- Bipedicled advancement flap.
- Y – V advancement flap / V – Y advancement flap.
- Cresentric advancement flap.

- ***Single pedicle advancement flap*:** Single pedicle advancement flaps are moved forward by

  i.) Using the property of skin elasticity.

  ii.) Excising Burrow's triangle on either side of the flap.

  iii) Pantographic expansion: The base of the flap is kept wide and by making back cut incisions at the base, the flap is moved forward. The defect produced by this movement is closed by medial movement of surrounding skin.

- ***Bipedicle advancement flap*:** Bipedicle advancement flap is planned parallel to the long axis of the defect. The defect is closed by the lateral movement of the flap and donor defect is closed by split thickness skin graft.

- *V- Y / Y – V* ***advancement flap.***
- ***Cresentic advancement flap*****:** For defects of the upper lip, perialar cresent can be excised to advance the cheek skin into the defect.

3. Sometimes flaps are classified and named based on their anatomical location eg. scalp flap, nasolabial flap, medial arm flap, abdominal flap, subaxillary flap, thigh flap etc.

DISTANT FLAPS.

When the donor area is situated at a distance from the primary defect i.e over other parts of the body, the flap is called distant flap. Distant flap can be single pedicle flap or tube pedicle flap.

Methods of transfer of distant flaps to the primary defect:

a. Direct flap transfer.

b. Indirect flap transfer.

a. *Direct flap transfer:*

Direct flap transfer of distant flap is possible in two ways,

By bringing the primary defects near the flap like transfer of subaxillary flap or transfer of groin flap over hand defect.

By bringing both flap and the defect near each other like cross leg flap.

b. *Indirect flap transfer*:

Indirect flap transfer takes longer time to transfer the flap to the distant site.

i.By wrist carrier.

ii.By migration.

***i. By wrist carrier*:** By wrist carrier, the flap is transferred to a distant site in two stages.

- Stage I : Flap is tubed and end of the tube is attached to the wrist on radial side.
- Stage II : After 4 weeks of attachment on the wrist the flap is divided from its donor site attachment and carried to its destination with its vascular attachment over wrist.

ii. ***By migration*:** During transfer of flap by migration – flap is tubed and in each stage, it does not move more than the length of the flap. Usually, it requires multiple stages to reach the

destination. The gap after each stage is usually 3 – 4 weeks. The various ways of migration are:

- Waltzing
- Caterpillar method
- Tumbling

B. MUSCLE FLAPS:

Vascular supply of the muscle is usually consistent in location, the size of the vessel makes it resistant to the effect of radiation and the deepest location makes it resistant to superficial trauma. Therefore, the muscle and musculocutaneous flaps have now become well established flaps in reconstructive surgery.

C. *FASCIAL FLAPS*:

Fascial flaps provide thin, durable cover with minimal donor site morbidity. Fascial flaps are very pliable. Temporoparietal fascial flap (TPFF) is an example of fascial flap.

D. *ADIPOFASCIAL FLAPS:*

Fascial flaps, adipofascial flaps and fasciocutaneous flaps are supplied by fasciocutaneous vascular system.

***Advantages* :**

1. Since skin is not incorporated in the adipofascial flap, it becomes more pliable. As a result the dog ears are less pronounced and it can easily be tailored to fit any wound.
2. Adipofascial flaps are turned over and the under surface is grafted. The major vessels of the extremities are preseved.
3. Donor site skin is preserved, thus preventing unsightly donor site defect.

E. *OMENTAL FLAPS:*

As free flap, it can be used to cover distant defects.

F.*COMPOUND FLAPS:*

When two or more different types of tissues are raised as flap, it is termed as compound flap. Musculocutaneous flap incorporates muscle and skin, osteomyocutaneous flap includes muscle, skin and bone and osteocutaneous flap includes skin and bone.

II. Island Flaps

In island flaps, the pedicle consists of only vessels with out skin bridge. It has greater mobility about its pivot point. Examples are superficial temporal artery island flap with island of scalp for eyebrow

reconstruction and neurovascular island flap from the ulnar side of the ring finger to provide sensory cover to the thumb.

III - Free flaps:

These are completely detached from the donor area before being transferred to the recipient area. The vascular supply at the recipient area is restored by anatomosing the vessels of the flap to the vessels of that area using microvascular technique.

Advantages

- It is an one stage procedure.
- The patient position in the post operative period is more comfortable.
- Required period of immobilization is shorter.
- It provides option for single stage reconstruction with restoration of sensation , incorporation of vascularized bone graft or functional muscle.

Disadvantages:

- It is technically a difficult operation. Specially trained personnel and microvascular set up is required.
- Duration of operation is longer.

CLINICAL APPLICATIONS

Indications:

1. To resurface avascular recipient beds.
    a. Bare bone, bare cartilage, exposed facial and cranial bones ear, nose and laryngeal cartilages etc.
    b. Irradiated bed in face
2. Exposed joints or exposed implants.
3. To reconstruct full thickness defects of cheeks, ears, eyelids, lips and nose.
4. For providing durable cover over pressure ulcers in occipital bones
5. For cosmetic reasons. eg. local flaps over face.

***Disadvantages*:**

Flaps are usually bulky, carry hairs in non hairy areas, leave scars over donor area and often require multiple operations to achieve final results.

PLANNING OF THE FLAP:

- Dimension of tissue loss – skin, muscle , bone and / or mucosa is assessed first.
- Decide about the type of reconstructive procedure required.
- Planning of the flap is done in reverse method.
- A flap should always be planned 10 – 20 % larger than required size.

Charactristics of an Ideal Flap

1.Safe and reliable

2.Functional restoration

3.Aesthetically pleasing

4. Low donor site morbidity

5.Single stage reconstruction.

TECHNIQUE OF THE SKIN FLAP ELEVATION:

- Flaps are handled as gently as possible.
- Flaps are raised at different planes in different areas:
  - Scalp – In loose areolar tissue deep to galea.
  - Chest & Limbs – with deep fascia.

- Abdomen and groin – superficial to abdominal muscles in loose areolar tissue plane.
- Face – Skin with underlying fat is raised without including the muscle or facial nerve.
- Aggressive thinning of subcutaneous tissue from a flap is avoided as it may jeoparadise the vascularity of the flap.
- Depending on the size of the defect and available surrounding defect, the donor area is either closed primarily or covered with split thickness skin graft.
- The raw area of the pedicle is covered by split thickness skin graft or tubed to avoid infection.

Immobilization :

All distant pediculated flaps need immobilization in a particular position in post operative period. This is achieved by appropriate splints.

The delay phenomena:

The delay is a surgical procedure that augments the blood supply of the flap.

Stage I :

Delay the flap by cutting it from three sides and elevating the extra length / full length from the bed.

Stage II :

Elevation of the flap after 10 – 14 days.

METHODS FOR ESTIMATING FLAP VIABILITY.

1. Fluorescein Test.
2. Laser Doppler Flowmeter.
3. Photoplethysmography.
4. Transcutaneous PO_2 measurement.
5. Other tests: Measurement of skin temperature, histamine wheal test, radioisotope study,
6. Atropine injected at the tip of flap and watch for signs of absorption.

Usually a pink and brisk dermal bleeding at the time of flap elevation indicates good vascularity.

IMPROVING COMPROMISED CIRCULATION OF THE FLAP.

1. Find out causes of flap necrosis like haematoma, kinking, necrosis, infection and treat accordingly.
2. Following desperate measures are taken, though these measures do not seem to benefit much.
    - Proper positioning to assist venous drainage.
    - Massage of the flap to improve venous drainage.
    - Intravenous transfusion of low molecular weight dextran in saline solution (500 ml / day for 3 days at a rate of 30 ml / hour) to reduce rouleaux formation.
    - Antiplatelet drug like aspirin (50 – 100 mg once a day) to increase capillary circulation.
    - Cooling of the flap (O^{0} to 20^{0} C).

COMPLICATIONS

- Haematoma
- Wound Infection
- Wound dehiscence
- Vascularity compromise
- Flap necrosis
- Graft loss
- Hypertrophic scar
- Contour deficit
- Functional disability
- Aesthetic deficit

Flap necrosis:

Flap necrosis occurs due to problems in arterial supply, venous drainage of skin or in both.

Causes of flap necrosis:

i. Inadequate vasculature

- Inadvertent damage to vascular pedicle.

- Damage to vascular pedicle by previous surgery, trauma, radiation or underlying disease (eg. atherosclerosis)

ii. Tension

- Inaccurate flap design.
- Faulty post operative position in case of distant flaps.

iii. Kinking

- Faulty flap planning
- Faulty post operative position.
- Oedema due to dependent position.

iv. Pressure

- Tight dressing, especially over pedicle.
- Tight subcutaneous tunnel for pedicle.
- Patient lying over flap in post operative period. Mild pressure may cause inadequate drainage. Excessive pressure will occlude the artery too.

v. Haematoma

- Failure to achieve perfect haemostasis.

- Non functioning drain.

vi. Infection

- Aggressive debridement of necrosed tissue.
- Antibiotics.

vii. Rough handling of flap

- Excessive use of forceps or rough manipulations during elevation of flap can lead to necrosis. Rough manipulation may damage the septocutaneous or musculocutaneous perforators.

Treatment of flap necrosis:

In spite of all possible measures, if the flap necrosis occurs, an aggressive approach is preferred for its management. If adequate viable length of the flap is available, the necrosed tissue is excised and reinset is given. If this is not possible due to short flap, a more conservative method is required. We wait till flap necrosis is well demarcated and then necrosed tissue is excised. The defect produced due to excision is resurfaced by skin graft / flap later on.

ISLAND FLAPS

Hisotry

Since the turn of this century, further refinement of carrying the pedicle had reached the point where flaps are transferred regularly on vascular and neurovascular bundles.

The principle of transfer without an intact epithelialised skin pedicle was initiated by ROBERT GERSUNY of Vienna in 1887, when he transferred composite tissue from neck to oral lining of cheek.

Theodre Dunham in 1892 raised forehead flap after dissecting out the vascular pedicle and buried it beneath the skin of the cheek.

Sheldon Horsley in 1915 beautifully illustrated the use of forehead flaps carried on temporal vessels in the journal of American Medical Association.

J.F.S. Esser in 1917 designed Island flaps from the neck based on a subcutaneous vascular pedicle and published in the New York journal of Medicine.

New Hampshire in 1954 suggested that neurovascular island flap techniques were useful in restoring the stereognosis to the hand. Littler discussed the use of neurovascular island flap.

Definition

In island flaps, the pedicle consists of only vessels with out skin bridge. It has greater mobility about its pivot point. Examples are superficial temporal artery island flap with island of scalp for eyebrow reconstruction and neurovascular island flap from the ulnar side of the ring finger to provide sensory cover to the thumb.

Island flaps are designed on the principle of transfer of tissue without an intact epitheliazed skin pedicle. Further refinements in design and techniques has reached a point where flaps are transfered on vascular and neurovascular bundles.

Advantages of islanding a flap

1. Flexibility, Mobility, arc of rotation is better compare to other conventional flap
2. Allows more distal reach of the flap
3. Complete inset
4. Better local tissue match

CLASSIFICATION OF ISLAND FLAPS

By nature of blood supply

1. Random island flap

Eg. V-Y advancement flap, nasolabial subcutaneous pedicle skin island flap, Key stone flap

2. Axial pattern island flap

Eg. Reverse sural artery island flap , Posterior interosseous artery island flap, Neurovascular island flap etc., (Littlers flap)

3. Perforator island flap

a) Transposition flap

b) Advancement flap

c) Rotation flap

d) Propeller flap

Eg: Superior gluteal artery perforator flap, Inferior epigastric artery perforator flap, Anterolateral thigh perforator flap.

Propellar Flap

The “perforator flap” and “propeller flap” methods have been combined as “perforator pedicled propeller flaps,” a new local flap method. The minimal definition of the propeller flap method is: a “skin island flap with axial rotation”.

Ex. Peroneal perforator flaps in leg defects

By the tissue components

1.Skin island flap

Eg. Nasolabial island flap, Postauricular island flap

2.Fasciocutaneous island flap

Eg: Radial forearm island flap, Peroneal perforator island flap

3.Musculocuteneous island flap

Eg. Tensor fascia lata island flap, Lattismus dorsi island flap

4.Osteomyocutaneous island flap

Pectoralis major osteomyocutanous island flap, Trapezious osteomyocutaneous island flap.

In our Study follwing interesting island flaps were performed and included from head to foot

1. Retroauricular island flap

- Vascular anatomy based on retroauricular branch of superficial temporal artery.
- We used for to cover the defect of lateral canthal region and exposed bony part of the zygoma.
- This flap is having three distinct components: The skin dermis and facial portion. This flap can be rotated 360°, pivot point being located at the level of tragus.

2. Temperoparietal island flap

- Contains axial superficial temporal vessels
- Used for reconstruction the defect of forehead, eye brow and cheeks.
- We used for post irradiated oro-cutaneous cheek defects because of its excellent blood supply and hair bearing region.

3. Pectoralis Major myocutaneous island flap

- This is one of the most significant musclocutaneous flap for head and neck reconstruction. It has a versatile blood supply and aesthetic appearance of donor scar.
- Pectoralis major origin from costal cartillages of 1 – 6 ribs
- Dominant blood supply is the thoracoacromial artery a branch of subclavian artery which traverse laterally from the mid portion of the clavicle for about 4c.m until it reaches the axis from the acromion to xiphoid, where it turns and runs along this line.
- Main artery lies close to the lower border of the muscle, so careful handling is needed.
- We used for carcinoma thyroid neck defect.

4.Lattismus Dorsi myocutaneous island flap

- Supplied by Thoracodorsal artery
- With the pivot point in the axilla, LDMC island flap can reach not only the anterior or posterior neck also the chin, cheek and lateral scalp.
- Point of entry is close to the lateral border, so chance of injury while handling the lateral border
- We used it for the defect of partial mastectomy

5.Neurovascular island flap - Hand

- Loupe is used .
- Common digital artery communicate to palmar metacarpal artery before dividing into proper digital artery in the palm. This communication has to be divided while raising the flap.
- Dorsal cutaneous artery to be divided before raising the flap in the finger.
- Truncal artery not to be damaged while dividing the above.
- In the palm, artery is superficial and in the digit nerves are superficial.
- We used for thumb pulp tip reconstruction

6.Tensorfascialata myocutaneous island flap

- Versatile flap
- Supplied by the ascending branch of the lateral circumflex femoral artery and its anastomosis circumflex iliac artery(external iliac system) and superior gluteal artery (internal iliac system)
- We used after the inguinal block dissection, TFL island flaps to the groin defects which prevents the lymphedema by transfer of the lymphatics to internal iliac system through the flap
- Dual purpose of the flap – coverage of the defect & transport of lymphatics

7.Gluteus maximus myocutaneous island flap

- It gives excellent soft tissue coverage for the sacral pressure sore defects and it is simpler to elevate the superior half of the gluteus maximus muscle.
- It is based on superior gluteal artery and musculocutaneous perforators.
- Donor defect was closed in a V-Y advancement primarily.
- We used for sacral pressure sore defect

8.Saphenous artery neurocutaneous island flap for upper 1/3 rd pretibial defects

- We used for the defect in the upper end of tibia with plenty of scar around the defect.
- Supplied by perivenous and perineuro capillary network along the long saphenous vein.
- The base of the island flap consist of only the long saphenous vein with its adventitia and surrounding areolar tissue. This narrow base allows for flap mobility in an arc from 0 to 170°.

9. Peroneal artery perforator based flap

- 15 cm from the lateral malleolus
- Not affected even in the diabetics
- Here it is used as Type B flap
- Not sacrificing the major artery
- If the Peroneal artery is included in the flap it becomes Type C flap. Here we are sacrificing the major artery
- We used for the exposed tendo achillis
- Since the peroneal vessels are not affected even in diabetics, inferiorly based flaps based on peroneal perforators laterally are more reliable than the flaps based on posterior tibial artery perforators medially

10.Median Forehead Island Flap

- Flap based on Supratrochlear artery
- It is used to resurface medial canthal and defects of dorsum of nose it gives better colour match, texture and form.
- We used for the defect in the dorsum of the nose followed by BCC excision.

11. REVERSED MEDIAN SURAL ARTERY ISLAND FLAP

- Distally based sural island flap is based on Vascular Axis around Sural nerve and its communications with lower perforator from the peroneal artery.
- Sural arterial network also communicate with posterior tibial artery.
- This communications are present at the level of Ankle joint 5cm above tip of lateral malleolus.
- This explains the versatility of the flap compared to all other inferior based flaps in the leg
- Coverage of defect around Ankle Dorsum and Ankle of foot upto the level of instep by conventional methods.
- Coverage of defect in entire Dorsum of foot and plantar aspect upto the level of great toe after preliminary delay of random extension of the flap upto popliteal crease.
- Conventionally this flap used to be raised on neurovascular pedicle with cuff of subcutaneous tissue surrounding it to safeguard vessel. This dissection will extend from the level of Anastomosis(5cm above LM) to the distal end of flap outlined proximally. The upper limit of the flap lies at junction between upper and middle 1/3 of

calf. This upper limit is determined by entry of Sural nerve and artery into the subcutaneous plane. Any extension proximal to that point has to be considered as random extension. The distal end of this conventional flap at its maximum will reach the instep area and not distal to it.

- We used for the to cover the calcaneal defect in the heel pad region.

12.MEDIAL PLANTAR INSTEP ISLAND FLAP FOR FOOT DEFECTS

Flap is based on medial plantar artery branch of Posterior tibial artery.

- It is a excellent flap for coverage of calcaneal defects
- Supplied by medial plantar artery is one of terminal branch of posterior tibial artery. Medial plantar nerve arise from tibial nerve accompanies the medial plantar artery.
- It has the advantage of being an arterialized sensory flap and is of good quality for the special requirements of plantar surface.
- We used for the defect of melanoma foot excision

13. Transverse Rectus Abdominis Myocutaneous island flap

Based on superior epigastric artery and useful in breast reconstruction.

- Most satisfying result in immediate post mastectomy reconstruction.
- TRAM island flaps based on circulation to the anterior abdominal wall that derives from perforating vessels through the rectus abdominis muscle and deep epigastric system branch from deep inferior and superior epigastric artery.
- The circulation from either rectus muscle across the lower abdomen is divided in to four Zones. Zone I immediately overlying the muscle the circulation is best. Zone II immediate across the midline. Zone III ipsilateral zone just lateral to the rectus muscle border and Zone IV is the contralateral rectus border the circulation some what variable in zone II and III and usually poor in Zone IV.
- It can provide aesthetically both appearance and feel and also benefit of an abdominoplasty.
- We used for post excisional defect of CA breast.

14.Reverse Posterior interosseous artery island flap

- Flap is supplied by retrograde perforating branches of anterior interosseous artery
- Used to cover dorsum of hand and first web space without interference to the two main arteries.
- We used for the post traumatic contracture over the dorsum of the hand.

15.Prepucial skin island flap

- We used as a single stage neourethroplasy for distal hypospadias.
- A transverse prepucial island flaps of the inner prepucial skin is separated with subcutaneous pedicle from the dorsal penile skin and spiraled around the ventral region. This tubed Vascularized flap is then anastomosed to proximal urethra delivered to tip of the glans.

16. Nasolabial island flap

- Flap is based on communication between angular and facial artery.
- We used for reconstruction of the ala of the nose lip.
- It gives better colour match, texture, form, and the donor site can be closed primarily.

MATERIALS AND METHODS.

Materials

This work includes the study of 30 patients who underwent reconstruction using island flaps for resurfacing defects from head to foot due to trauma ,congenital lesions or surgical extirpation of tumour.

The patients who were admitted to Plastic Surgery, Surgical Oncology and General Surgery wards at Government Rajaji Hospital, Madurai, were studied between September 2005 – April 2008.

Methods

The methods include obtaining information from patients, thorough clinical examination and doing necessary investigations for management. All informations were entered in a proforma specially designed for this study.

Methodology

The patient's name,age, sex, history of presenting illness and its duration was obtained. Past history of chronic medical and surgical illness noted. Personal history like smoking, alcohol consumption and diet pattern were obtained.

Detailed physical examination of the defect was made and tissue diagnosis was recorded and reconstruction planned accordingly.

Basic investigations like blood Hb estimation, urine examination, blood sugar and renal parameters like urea, creatinine were done. Serum protein levels were assessed.

X ray chest and ECG were taken. Doppler study was performed to identify and preoperatively mark the perforator vessels in selected cases.

Cardiac status was examined by specialist of our institution. Diabetic patients were treated on Diabetologist opinion.

Based on the above investigations, patients were assessed for general anaesthesia and managed surgically. Intraoperative, post operative complications were noted and managed accordingly. All the patients were reviewed in our OP department.

Management

All the patients were informed about the surgical procedures,the intraoperative, post operative complications and rehabilitation.

Preoperative preparations were done and preoperative antibiotics were given. Patients were operated under general anaesthesia or regional anaesthesia.

The patients who were planned for surgery were prepared on the previous day. A detailed informed consent regarding the procedure and its complications was obtained.

The patients were taken up for surgery in the morning in the respective theatre by the plastic surgeons, surgical oncologist, general surgeons and post excisional defect was reconstructed by the plastic surgeons.

Postoperatively all the patients were managed by plastic surgeons until recovery of the patient. Blood transfusion was given if indicated. If necessary patients were observed in the intensive respiratory unit for a couple of days.

After surgery patients were discharged and advised for follow up.

Follow up

The patients were followed up every fifteen days, one month, two months, three months , six months and one year. The maximum follow up was for two years.

OBSERVATIONS

Reconstuction using flaps are performed regularily in all operation theatres for defects from head to foot. Out of these 16 interesting island flaps excuted in 60 patient during the period of Sep 2005 to Jan 2008 and were taken up for this study.

Table I

Age Vs gender

Gender	1-15	16 – 30	31—45	46 – 60	61 – 75	> 76	Total
Male	4	4	10	12	4	2	36
Female	2	2	6	6	6	2	24
Total	6	6	16	18	10	4	60

All cases were in the age group from 6 – 80 years.

60 % cases were male and 40 % were female in our study.

Table II

Risk factors for surgery

Risk Factors	No. of cases	%
Diabetes mellitus	12	20
Hypertension	8	13.3
Smoking	12	20
Peripheral vascular disease	4	6.6

Table III

Aeitiology of Defect

Aetiology of defect	No. of cases	%
Tumour surgery	30	50
Trauma	24	40
Congenital	6	10

Majority of the defects were either due to trauma or post tumour resection.

Table IV

Anatomical site of defects

Report	No of cases	%
Head and neck	16	26.6
Trunk	20	33.3
Upperlimb	10	16.6
Lowerlimb	14	23.3

In this study majority of the defects were of the trunk, followed by head and neck region.

Table - V

Anatomical sites of flap

Site of island flap	No. of cases	%
Forehead	4	6.6
Retroauricular	2	3.3
Nasolabial	2	3.3
PMMC	8	13.3
LD	4	6.6
TRAM	2	3.3
PIA	4	6.6
NVI hand	4	6.6
GMMC	6	10
TFL	4	6.6
RSA	6	10
Saphenous artery	2	3.3
Prepucial skin	6	10
Peroneal perforator	4	6.6
Medial Plantar	2	3.3

Table VI

TYPES OF FLAPS

Types of Flap	No. of cases	%
Skin island	18	30
Fasciocutaneous	18	30
Myocutaneous	24	40

In this study, an almost equal distribution of all types of flaps were performed.

Table VII - Types of Flaps

Type of flap	No. of cases	%
Sensory	8	13.3
Non-Sensory	52	86.6

In this study, 4 cases of sensory flap which included Neurovascular island flap, saphenous artery and medial plantar island flap were performed.

Table – VIII

VASCULAR PATTERN OF FLAPS

Types of Flap	No. of cases	%
Random	8	13.3
Axial pattern	42	70
Perforator based	10	16.6

Table IX

Donor site Management

Donor site	No. of cases	%
Primary closure	26	43.3
SSG	34	56.6

Almost half of the donor sites in our study were closed primarily.

Table X

Complications

Complications	No.of cases	%
Haematoma	8	13.3
Wound Infection	4	6.6
Wound dehiscence	4	6.6
Vascularity compromise	2	3.3
Flap necrosis	2	3.3
Graft loss	4	6.6
Hypertrophic scar	8	13.3
Contour deficit	8	13.3
Functional disability	8	13.3
Aesthetic deficit	12	20

In this study, 13% of patients had haematoma. Wound dehiscence, infection and graft loss were seen in 6.6% each. One patient had flap necrosis which was only partial thickness.

As late complications, 13 % each of hypertrophic scar, contour deficit and functional disability like pseudomotor skin changes were noted. 80 % of patients has an excellent aesthetic outcome.

DISCUSSION

Island flaps are based on reliable, anatomically defined vascular territory within the flap, which have been raised beyond the constraints of limited Length to breath ratio, usually associated with random flaps, depending upon the vascular pattern flap may be random, Axial & perforator based.

Regarding the etiology of the defect 50% of cases was Tumor surgery with excisional defect, 40% cases was Traumatic defect and remaining 10% was congenital defects.

All the cases were in the age group from 6-80 years. 60% cases were male and 40% were female more than 50% cases were with in the age group of 30-60% in our study.

Diabetic mellitus, hypertension, smoking and peripheral vascular disease were commonly associated risk factors accounding 20% cases, but vascular compromise in our study was only 3.3%, hence island flaps are safer to perform even with systemic risk factors and in some cases vascular supply of the flap confirmed by doppler.

Depending upon the loacation of the defect, we performed 16 cases in the head and neck region, 20 cases in the Trunk, 10 cases in the upper limb and 14 cases in the Lower limb. Majority of the cases from Trunk, followed by head & neck region.

We used Island flaps in all the regions of the body from Head to Foot.

Since all the flaps were locally based, it gives better color match, texture, form are aesthitically acceptable. The arc of rotation of the flap is more can be turned it around 180°. It gives better inset in to the defect without tension and dog ear, even though most of the flaps were non sensory in our study, sensory flap was also performed with good success especially in finger and foot defects with excellent tissue match.

In our studies, all the flaps used in reconstruction were single stage without delay.

Almost half of the donor site defect were closed primarily and remaining defects were closed by split skin graft.

We used pharmacological drugs like aspirin, Pentoxiphyllin, Ibubrufen to improve the vascularity for all the flaps in the post operative period.

In our studies, we encountered all types of acute minor complications, like haematoma which was drained, wound infection was treated with appropriate antibiotics, wound dehiscence treated by secondary suturing and minimal graft loss healed by secondary intention. One case of flap necrosis with partial thickness loss which was managed with split skin graft. Late complications like hypertrophic, scar contour deficit were managed by using intralesional steroids and pressure garments.

The patients were followed up regularly and the average period was upto 6 months.

CONCLUSION

1. Island flaps are based on reliable anatomically defined vascular territory with in the flap – blood supply is reliable and robust.
2. The reliability and volume of tissue that can be placed into the defect is markedly greater than any random pattern flap.
3. Delay procedure was unnecessary when moblizing large tissue volumes in a single procedure based on the direct circulation.
4. Arc of rotation is more compared to pedicle flap
5. Inset is complete and satisfactory.
6. Local tissue match - similarity in skin color, texture form contour and aesthesis etc., is excellent.
7. Restoration of function whether motor or sensory is possible in certain flaps.
8. Single stage procedure
9. Most of the donor size can be closed primarily, donor site morbidity also negligeable
10. As good as free flap and minimize the indication for free flap.

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ABBREVIATION

SM	-	Smoking
DM	-	Diabetes Mellitus
HT	-	Hypertension
PVD	-	Peripheral Vascular Disease
PP	-	Peroneal Perforator
GMMC	-	Gluteus Maximus Myocutaneous
PMMC	-	Pectoralis Major Myocutaneous
RSA	-	Reverse Sural Artery
PIA	-	Posterior Intrasseous Artery
LD	-	Lattismus Dorsi
TFL	-	Tensor Facia Lata
NVI	-	Neuro Vascular Island
TRAM	-	Transverse Rectus Abdominis
FC	-	Faciocutaneous
MC	-	Myocutaneous
WI	-	Wound Infection
WD	-	Wound Dehiscence
FN	-	Flab Necrosis
CD	-	Contour Deficit
VC	-	Vascular Compromise
FD	-	Functional Deficit

DEPT OF PLASTIC, HAND, RECONSTRUCTIVE &

MICROVASCULAR SURGERY.

GOVERNMENT RAJAJI HOSPITAL, MADURAI MEDICAL COLLEGE

ISLAND FLAPS FOR RECONSTRUCTION

Prof. Dr. ***V.Narayanan*** **M.S.,M.Ch.,**

2005 - 2008

Name: Ward :

Age : Address:

Sex :

Occupation:

I.P. No.

D.O.A DIAGNOSIS.

D.O.S

D.O.D

TREATMENT

C/ O

H/o

- Defect

Past & Personal H/ O

- Diabetes/ Hypertension/ Smoking / Peripheral Vascular disease/ Alcohol intake

General Examination:

- Anaemia / Avitaminosis / Icterus
- pedal edema / Generalised lymphadenopathy

Investigations:

Basic Investigation in Blood, Urine, X ray, ECG,Doppler,Wound swab

Defect.

Size, shape, number, site, surrounding area.

Tissue diagnosis

Operative Notes:

Flap used

Complications :

Post operative follow up:

Rehabilitation :